CLAIMS

1. (Previously presented) A receiver for identifying a message based upon a received signal, the receiver comprising:

a processor that generates a minimum threshold and a maximum threshold representing a range for each of a plurality of possible message levels, wherein the sizes of the ranges are different for at least two of the message levels, and

a comparator that identifies the message by comparing the received signal with the generated minimum and maximum thresholds.

2. (Original) The receiver according to claim 1, wherein the minimum and maximum thresholds are a function of an interrelationship between noise and the message level.

3. (Original) The receiver according to claim 2, wherein the minimum and maximum thresholds are a function of the interrelationship between digital impairment and the message level.

4. (Original) The receiver according to claim 2, wherein the minimum and maximum thresholds are a function of the interrelationship between coherent noise and the message level.

5. (Currently amended) The receiver according to claim 1, wherein the generated minimum and maximum thresholds define a range wherein [[the]] a probability of correctly receiving a selected signal exceeds a selected probability P0.

6. (Original) The receiver according to claim 5, wherein the processor includes a means for calculating the mean value, Lev(i), within a selected range defined by a selected set of minimum and maximum thresholds.

7. (Currently amended) The receiver according to claim 6, wherein the processor includes a means for calculating a distance d(i) between received signal levels, the distance d(i) being calculated according to the equation:

$d(i) = Lev(i+1) - Lev(i) - Lmse(i+1) - Lmse(i)$,

wherein the term "i+1" identifies a message level adjacent the i^{th} message level in [[the]] a constellation design for the receiver and wherein Lmse(i) is the level mean square error for the i^{th} message level.

8. (Original) The receiver according to claim 7, wherein the distance $d(i) > d_{min}$ for all message levels.

9. (Original) The receiver according to claim 1, wherein the processor includes means for determining a distance d(i) between received signal levels, the distance d(i) having different values for a plurality of message levels.

10. (Previously presented) A method of forming a constellation design having a selected number of message levels, the constellation design forming part of a receiver that identifies a transmitted message based upon a received signal, the method comprising:

determining a minimum threshold and a maximum threshold representing a range for each of a plurality of possible signal levels, wherein the sizes of the ranges are different for at least two of the message levels, and

calculating the distance d(i) between the maximum threshold for possible signal level (i) and the minimum threshold for possible signal level (i+1).

11. (Original) The method according to claim 10, wherein the determining step comprises the steps of:

identifying a probability density function for each possible signal level Y, and

identifying the minimum and maximum thresholds as the boundaries of a range in the identified probability density function wherein the probability of correctly receiving a selected message level exceeds a selected probability P0.

12. (Original) The method according to claim 11, wherein the step of identifying the probability density function comprises the steps of:

transmitting data points to the receiver, and

recording the received signal level associated with each of the transmitted data points.

13. (Original) The method according to claim 10, wherein the step of calculating the distance d(i) between received signal levels further includes the steps of:

determining the mean value, Lev(i), for a selected variable range identified by a selected set of minimum and maximum thresholds, and

calculating the distance d(i) as a function of Lev(i).

14. (Original) The method according to claim 13, further including the step of calculating the distance d(i) in accordance with the equation:

$$d(i) = Lev(i+1) - Lev(i) - Lmse(i+1) - Lmse(i);$$

wherein the term "i+1" identifies a message level adjacent the i^{th} message level in the constellation design for the receiver and wherein Lmse(i) is the level mean square error for the i^{th} message level.

15. (Original) The method according to claim 13, further comprising the step of identifying whether the calculated distance $d(i) > d_{min}$, wherein d_{min} represents a selected minimum value.

16. (Original) The method according to claim 15, further comprising the step of adjusting the constellation design such that the distance $d(i) > d_{min}$ for all received signal levels in the constellation design.

17. (Original) The method according to claim 12, further comprising the step of calculating the mean value, Lev(i), according to the equation:

$$Lev(i) = \frac{1}{N}\sum_{i=1}^{N} L(i),$$

wherein L(i) is the training data received by the receiver, and

N is the number of times training data for the i^{th} level is sent.

18. (Original) The method according to claim 17, further comprising the step of calculating the standard mean square error, σ^2, according to the equation:

$$\sigma^2 = \frac{1}{N}\sum_{i=1}^{N} [L(i) - Lev(i)]^2.$$

19. (Previously presented) The method according to claim 18, further comprising the step of calculating the Lmse(i) according to the equation:

$\text{Lmse} = \alpha\sigma^2$,

where α is a coefficient parametrically defined by the following equation

$$P0 = \frac{\int_{-\alpha\sigma^2}^{\alpha\sigma^2} e^{\frac{-x^2}{2\sigma^2}} dx}{\int_{-\infty}^{\infty} e^{\frac{-x^2}{2\sigma^2}} dx}$$, where P0 is a selected probability and x is an integration variable.

20. (Previously presented) A receiver for identifying a transmitted message based upon a received signal, the receiver comprising:

a processor for generating a constellation design having a minimum threshold and a maximum threshold for each of a plurality of possible signal levels, the minimum and maximum thresholds for each possible signal level representing a range, wherein the sizes of the ranges are different for at least two of the possible signal levels, and

a comparator that identifies the transmitted message by comparing the received signal with the generated constellation design and that generates an output signal representative of the transmitted message.

21. (Previously presented) A method of identifying a message based upon a received signal, the method comprising:

receiving the signal,

providing a minimum threshold and a maximum threshold representing a range for each of a plurality of possible message levels, wherein the sizes of the ranges are different for at least two of the message levels, and

identifying the message by comparing the received signal with the generated minimum and maximum thresholds.

22. (Original) The method according to claim 21, wherein the minimum and maximum thresholds are generated as a function of an interrelationship between noise and the message level.

23. (Original) The method according to claim 22, wherein the minimum and maximum thresholds are generated as a function of the interrelationship between digital impairment and the message level.

24. (Original) The method according to claim 22, wherein the minimum and maximum thresholds are generated as a function of the interrelationship between coherent noise and the message level.

25. (Previously presented) The method according to claim 21, further comprising the step of calculating a variable range Lmse(i) for each possible message level Y, Lmse(i) representing one-half the distance between the minimum and maximum thresholds for each possible message level, wherein the minimum and maximum thresholds define a range wherein the probability of correctly receiving a selected signal exceeds a selected probability P0.

26. (Original) The method according to claim 25, further including the step of calculating the mean value, Lev(i), within a selected range defined by a selected set of minimum and maximum thresholds.

27. (Original) The method according to claim 26, further including the step of calculating a distance d(i) between received signal levels, the distance d(i) being calculated according to the equation:

$d(i) = Lev(i+1) - Lev(i) - Lmse(i+1) - Lmse(i)$.

28. (Original) The method according to claim 21, further including the step of determining a distance d(i) between received signal levels, the distance d(i) having different values for a plurality of message levels.

29. (Original) The method according to claim 28, wherein the step of calculating the distance d(i) between received signal levels further includes the steps of:

determining the mean value, Lev(i), for a selected variable range identified by a selected set of minimum and maximum thresholds, and

calculating the distance d(i) as a function of Lev(i).

30. (Original) The method according to claim 28, further comprising the step of identifying whether the calculated distance $d(i) > d_{min}$, wherein d_{min} represents a selected minimum value.

31. (Currently amended) The method according to claim 30, further comprising the step of adjusting [[the]] a constellation design such that the distance $d(i) > d_{min}$ for all received signal levels in the constellation design.

32. (Previously presented) The method according to claim 21, further comprising the steps of:

identifying a probability density function for each possible signal level Y, and

identifying the minimum and maximum thresholds as the boundaries of a range in the identified probability density function wherein the probability of correctly receiving a selected message level exceeds a selected probability P0.

33. (Original) The method according to claim 32, wherein the step of identifying the probability density function comprises the steps of:

transmitting data points to the receiver, and

recording the received signal level associated with each of the transmitted data points.

34. (Original) The method according to claim 33, further comprising the step of calculating the mean value, Lev(i), according to the equation:

$$Lev(i) = \frac{1}{N}\sum_{i=1}^{N} L(i),$$

wherein L(i) is the training data received by the receiver, and

N is the number of times training data for the i^{th} level is sent.

35. (Original) The method according to claim 34, further comprising the step of calculating the standard mean square error, σ^2, according to the equation:

$$\sigma^2 = \frac{1}{N}\sum_{i=1}^{N} [L(i) - Lev(i)]^2 .$$

36. (Previously presented) The method according to claim 35, further comprising the step of calculating the Lmse(i) according to the equation:

$\text{Lmse} = \alpha\sigma^2$,

where α is a coefficient parametrically defined by the following equation

$$P0 = \frac{\int_{-\alpha\sigma^2}^{\alpha\sigma^2} e^{\frac{-x^2}{2\sigma^2}} dx}{\int_{-\infty}^{\infty} e^{\frac{-x^2}{2\sigma^2}} dx}$$, where P0 is a selected probability and x is an integration variable.

37. (Previously presented) A receiver for identifying a message based upon a received signal, the receiver comprising:

a processor that generates a minimum threshold and a maximum threshold representing a variable range for each of a plurality of possible message levels in a single constellation design, and

a comparator that identifies the message by comparing the received signal with the generated minimum and maximum thresholds, wherein the minimum and maximum thresholds are a function of an interrelationship between noise and the message level.

38. (Currently amended) [[A]] The receiver according to claim 1, wherein ~~for identifying a message based upon a received signal, the receiver comprising~~:

~~a processor that generates a minimum threshold and a maximum threshold representing a variable range for each of a~~ the plurality of possible message levels [[in]] belongs to a single constellation design, and

~~a comparator that identifies the message by comparing the received signal with the generated minimum and maximum thresholds, wherein~~ the minimum and maximum thresholds define a range wherein [[the]] a probability of correctly receiving a selected signal exceeds a selected probability P0.

39. (Currently amended) [[A]] The method according to claim 10 ~~of forming a constellation design having a selected number of (i) message levels, the constellation design forming part of a receiver that identifies a transmitted message based upon a received signal, the method comprising:~~

~~determining a minimum threshold and a maximum threshold representing a variable range for each of a plurality of possible signal levels in the constellation design, and~~

~~calculating the distance d(i) between possible signal levels based upon the determined minimum and maximum thresholds~~, wherein the determining step comprises the steps of:

identifying a probability density function for each possible signal level Y in the constellation design, and

identifying the minimum and maximum thresholds as the boundaries of a range in the identified probability density function wherein the probability of correctly receiving a selected message level exceeds a selected probability P0.

40. (Previously presented) A method of forming a constellation design having a selected number of (i) message levels, the constellation design forming part of a receiver that identifies a transmitted message based upon a received signal, the method comprising:

determining a minimum threshold and a maximum threshold representing a variable range for each of a plurality of possible signal levels in the constellation design, and

calculating the distance d(i) between possible signal levels based upon the determined minimum and maximum thresholds, including the steps of:

determining the mean value, Lev(i), for a selected variable range identified by a selected set of minimum and maximum thresholds, and

calculating the distance d(i) as a function of Lev(i) in accordance with the equation:

d(i) = Lev(i+1) – Lev(i) – Lmse(i+1) – Lmse(i);

wherein the term "i+1" identifies a message level adjacent the i^{th} message level in the constellation design for the receiver and wherein Lmse(i) is the level mean square error for the i^{th} message level.

41. (Previously presented) A method of forming a constellation design having a selected number of message levels, the constellation design forming part of a receiver that identifies a transmitted message based upon a received signal, the method comprising:

determining a minimum threshold and a maximum threshold representing a range for each of a plurality of possible signal levels;

calculating the distance d(i) between possible signal levels based upon the determined minimum and maximum thresholds, including the steps of:

determining the mean value, Lev(i), for a selected variable range identified by a selected set of minimum and maximum thresholds, and

calculating the distance d(i) as a function of Lev(i);

identifying whether the calculated distance $d(i) > d_{min}$, wherein d_{min} represents a selected minimum value; and

adjusting the constellation design, when $d(i) \leq d_{min}$.

42. (Previously presented) A method of identifying a message based upon a received signal, the method comprising:

receiving the signal,

generating a minimum threshold and a maximum threshold representing a variable range for each of a plurality of possible message levels in a single constellation design, and

identifying the message by comparing the received signal with the generated minimum and maximum thresholds, wherein the minimum and maximum thresholds are a function of the interrelationship between noise and the message level.

43. (Previously presented) A method of identifying a message based upon a received signal, the method comprising:

receiving the signal,

generating a minimum threshold and a maximum threshold representing a variable range for each of a plurality of possible message levels in a single constellation design, and

identifying the message by comparing the received signal with the generated minimum and maximum thresholds, wherein the generating step includes the step of calculating a variable range Lmse(i) for each possible message level Y, Lmse(i) representing one-half the distance between the minimum and maximum thresholds for each possible message level, wherein the minimum and maximum thresholds define a range wherein the probability of correctly receiving a selected signal exceeds a selected probability P0.

44. (Previously presented) A method of identifying a message based upon a received signal, the method comprising:

receiving the signal,

generating a minimum threshold and a maximum threshold representing a variable range for each of a plurality of possible message levels in a single constellation design,

identifying the message by comparing the received signal with the generated minimum and maximum thresholds, and

determining a distance d(i) between received signal levels, the distance d(i) having different values for a plurality of message levels, including the steps of:

determining the mean value, Lev(i), for a selected variable range identified by a selected set of minimum and maximum thresholds, and

calculating the distance d(i) as a function of Lev(i).

45. (Currently amended) [[A]] The method according to claim 21, wherein ~~of identifying a message based upon a received signal, the method comprising~~:

~~receiving the signal;~~

~~generating a minimum threshold and a maximum threshold representing a variable range for each of a~~ the plurality of possible message levels [[in]] belongs to a single constellation design, and

~~identifying the message by comparing the received signal with the generated minimum and maximum thresholds;~~

the method includes the steps of:

determining a distance d(i) between received signal levels, the distance d(i) having different values for [[a]] the plurality of message levels, and

identifying whether the determined distance $d(i) > d_{min}$, wherein d_{min} represents a selected minimum value.

46. (Currently amended) [[A]] The method according to claim 21, wherein ~~of identifying a message based upon a received signal, the method comprising~~:

~~receiving the signal~~;

~~generating a minimum threshold and a maximum threshold representing a variable range for each of a~~ the plurality of possible message levels [[in]] belongs to a single constellation design, and

the method includes~~ing~~ the steps of:

identifying a probability density function for each possible signal level Y, and

identifying the minimum and maximum thresholds as the boundaries of a range in the identified probability density function wherein the probability of correctly receiving a selected message level exceeds a selected probability P0~~; and~~

~~identifying the message by comparing the received signal with the generated minimum and maximum thresholds~~.

47. (Currently amended) A method of identifying a message based upon a received signal, the method comprising the steps of:

receiving the signal;

providing a minimum threshold and a maximum threshold representing a range for each of a plurality of possible message levels in a single constellation design, wherein the maximum threshold for a possible message level (i) is separated from the minimum threshold for a possible message level (i+1) by a distance d(i) and the sizes of the ranges are different for at least two of the message levels; and

identifying the message by comparing the received signal with the minimum and maximum thresholds.

48. (Canceled)

49. (Previously presented) The method of claim 47, wherein the distances d(i) are different for at least two different pairs of message levels.

50. (Previously presented) The method of claim 47, further comprising the step of generating the minimum and maximum thresholds using transmitted training signals.

51. (Previously presented) The method according to claim 41, wherein the step of adjusting comprises removing from the constellation design a message level that gives rise to $d(i) \leq d_{min}$.

52. (Previously presented) The method according to claim 41, wherein the sizes of the ranges are different for at least two of the message levels.